

5. *St. Paul's Church*

F A R T H E R  
H I N T S

F O R R E S T O R I N G

A N I M A T I O N,

A N D F O R

P R E S E R V I N G M A N K I N D

A G A I N S T T H E P E R N I C I O U S I N F L U E N C E O F

N O X I O U S V A P O U R S,

O R,

C O N T A M I N A T E D A I R,

I N A

S E C O N D L E T T E R T O D R. H A W E S.

*Ad utilitatem vitæ, omnia consilia fastaque nostræ  
dirigenda sunt. Cic.*

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L O N D O N :

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FARTHER HINTS, &c.

DEAR SIR,

THE very obliging terms of approbation which YOU, and the HUMANE SOCIETY have been pleased to express concerning my late Hints on Animation, claim my warmest acknowledgments. An enquiry so new and interesting to humanity, deserved indeed a much abler pen, yet the indulgence which I have experienced from those who best know the difficulty of the undertaking, encourages me to resume the subject. That candour which liberal minds are wont to shew to every exertion in so good a cause, must plead for the many imperfections of my former, as well as of the present letter.

Not long ago any attempt to recover persons apparently dead would have been ridiculed as visionary, and absurd, and the authentic facts which this and other humane institutions have of late years presented to the astonished world, would formerly have been considered as entirely supernatural. Great and uncommon however as the success may appear, yet the art of restoring Animation, must be confessed to be but yet in its very infancy. Its principles being still but little understood, the methods proposed by the different societies are far from being well established, some of them being of a doubtful nature, others very inadequate, and all but too often greatly disproportionate to our expectations. The improvements which I ventured to suggest, depend chiefly on a prudent management of dephlogisticated air, electricity, and heat, three of the most powerful agents in nature; and I have the pleasure to  
 assure

assure you that the theory is now capable of being farther illustrated by some additional facts and observations. As truth is the grand object of the present investigation, my wish is that the plan proposed may be brought to the touchstone of experience, that the advantages and disadvantages being alike fairly stated, a true estimate may at length be formed.

1st, DEPHLOGISTICATED AIR—  
*its application to medical purposes, particularly*  
 in RESTORING ANIMATION.

Of the various aërial fluids lately brought to light by experimental Philosophy, this seems to be most interesting to the physician, and perhaps best intitled to stand at the head of this new class of bodies, whose properties have been so successfully investigated by the truly ingenious Dr. PRIESTLEY. But in vain does the illustrious PHILOSOPHER

PHER consume his time, his health, his abilities, in thus enlarging the boundaries of science, unless the attentive Physician seconds his endeavours by applying his discoveries to the advancement of the healing art, and to the benefit of Mankind. It is the Physician's province to take up the various substances in nature, where the Philosopher leaves them, and to avail himself of their particular properties for the preservation of health, or for the cure of diseases. Agreeable to this enlarged idea is that excellent adage,

“ *Quo desinit Philosophus incipit Medicus.*”

As animal life and flame are alike extinguished by contaminated air, so pure air seems to be the natural *pabulum* of each, and to preserve their vigour in proportion to its purity. But what is contaminated air but air loaden with phlogiston and certain noxious effluvia ?



effluvia? Or what is dephlogisticated air, but air divested of these adventitious matters, and brought to a high degree of purity? By this train of thinking, I was first induced to consider dephlogisticated air as better adapted than common air for re-kindling the vital flame when nearly extinguished by drowning, suffocation, or noxious vapours\*. But to determine how far the theory is consonant to reason, it may not be amiss briefly to consider the nature and cause of death under these circumstances, concerning which

\* I am the more confirmed in this opinion now that I find it supported by the collateral evidence of other ingenious gentlemen, though very remote from each other. A circumstance unknown to me till very lately. Thus M. ACHARD, at Berlin, Dr. STOKES, at Edinburgh, and Mr. JOHN HUNTER, in London, without any participation of sentiments, concur with me in this idea.

which Pathologists are still much divided. Mr. Louis, many years ago, endeavoured by experiments to convince the French Academicians, that drowning consisted in water being admitted into the windpipe. This conclusion was warmly controverted by M. SENAC, PETIT, and others, who attributed it to a surcharge of blood in the brain, and therefore considered it as a real apoplexy. At length Dr. DE HAEN, with a laudable desire of clearing up the difficulty, performed a variety of experiments on dogs, by drowning some and hanging others, and by examining the internal parts of many of them after death\*. The result was, that the brain, especially of those which were hanged, was generally found without any appearance of extravasation that could produce apoplexy; sometimes however he acknowledges there

\* Ratio Medendi cont. P. 2.



were evident marks of inflammation, and distention, yet these he attributes to some prior cause. On the whole, the result cannot be considered to be perfectly decisive. The bronchia of those that were drowned contained a portion of water in a frothy state, tinged with the colouring ingredient, which (in imitation of M. LOUIS) he had put into the water before the animals were immersed. The lungs and cavities of the heart were generally distended, and what was very remarkable the aperture of the glottis open, and favourable to the admission of a fluid. Thus was the entrance of water into the lungs demonstrated, and the doctrine of M. LOUIS apparently confirmed; but whether the water entered in the act of drowning, or after, or whether it was to be regarded as the cause or consequence of death, we are still left wholly in the dark; wherefore an

accurate investigation of the phenomena in the *human* subject is yet much wanted, agreeably to what was hinted in my last. That the water inspired in the above mentioned animals, was rather a consequence seems more probable, because the quantity appears to have been inadequate to cause death so suddenly, and in some of the cases was entirely wanting; besides, in the Hydrothorax, where the lungs are almost deluged with water, the disease does not prove so immediately fatal. A successive ingress and egress of air to and from the lungs being essential to life, the intermission of it, though but for a few minutes, suspends the action of that organ; hence may be readily understood why compressing the windpipe dispatches animals with equal certainty, and nearly in the same space of time as submersion in water, and consequently why these different modes of intercepting

tercepting the influx of respirable air into the lungs, equally tend to abolish their action and that of the other vital organs. This being accomplished, the muscles become paralytic, and the epiglottis is rendered incapable of performing its office. Is it to be wondered at then, if, in this state, a portion of the fluid in which an animal is immersed, should insinuate itself into the lungs? This however does not seem to take place, at least in the human species, till the powers of life are entirely suspended, and even then in but small quantity. For if the apperture of the *glottis* ever remained open, as represented in DE HAEN's experiments, it is difficult to conceive how the windpipe could escape being completely filled with water during submerfion, or why there should be any resistance met with in the introduction of

the catheter into its orifice in the recovery of drowned persons.

Nature has endowed the interior surface of this tube with a peculiar sensibility, by which it is rendered "tremblingly alive," to the touch of every fluid except respirable air. Hence, if but a drop of water, or any other liquor however mild, by accident gains admission into its orifice, this like a faithful guardian instantly gives the alarm, and excites a violent cough to expell it. And there is the highest reason to believe that in the article of drowning the same power is vigorously exerted in securing the entrance into the larynx, by inducing a firm constriction, which continues till the contractile power of the muscles is destroyed. Therefore although water may find admission after this constriction is relaxed, yet, with deference to these able Pathologists,

thologists, this cannot easily happen till the vital functions are already abolished, and therefore cannot with propriety be considered as the cause, but rather as the consequence of drowning.

Noxious air, that insidious enemy of life, finds more easy admission into the windpipe, and proves more immediately fatal than strangulation, submerision in water, or even confinement in *vacuo*. This appears evident from the sudden effects of the Grotto del Cani, fumes of sulphur, charcoal and other bodies which exhale phlogiston, or mephitic air. Yet phlogisticated air, though highly noxious to life, does not seem to act by exciting pain, or irritation, when applied either to the internal surface of the stomach, or intestinal canal, but by a peculiar sedative power on the bronchial and olfactory nerves, by  
 which

which it suspends their influence. Hence the symptoms which it produces are of the soporific kind, as stupor, syncope, apoplexy or immediate death. But what is very remarkable when life is suddenly extinguished in this way, the body, instead of becoming rigid, remains generally quite flexible, as when struck with lightning, which perhaps hereafter will be found to be only a higher species of phlogification.

Air rendered impure by being often respired acquires the same deleterious properties, and becomes equally destructive to animal life. Hence the lungs seem evidently intended to inhale pure respirable air, and to discharge a proportionable quantity of contaminated air. Now if the mere shutting out the former for a few minutes suspends the action of the lungs, the retention of the latter cannot but hasten its final extinction.



tion. From whatever cause respiration is stopped, a quantity of phlogisticated air remains stagnant in the cells of the windpipe. This by its sedative power specifically exerted on that organ, by degrees destroys the remnant of irritability, and thus, though hitherto unnoticed, probably gives the *coup de grace* in all fatal cases, at least of the pulmonic kind. Hence perhaps may be explained the disagreeable sense of suffocation which is felt on forcibly holding in the breath for a few seconds; and why if this is protracted beyond a certain time, the intolerable anxiety which it excites becomes at length incompatible with life? In this case, as in drowning, the lungs cease to expand, the heart to beat, and finally, the machine with all its movements, like a clock whose pendulum is stopped, remains entirely at rest.

Yet

Yet renew but the action of the lungs in one, and touch but the pendulum of the other, and all again is life, and motion\*.

These

\* During this awful pause the mental as well as the corporeal faculties are obliterated, and all ideas of consciousness abolished. Might not a temporary suspension of this nature (if it could be safely imitated by art) bid fair to produce more lasting and salutary changes in certain highly obstinate affections of the brain and nerves than can be accomplished by any ordinary means? If canine madness was completely cured by a suspension of the functions in consequence of accidental submersion, and if VAN HELMONT was able to practise this method with safety and success in similar instances \*, might not the like happy effects be expected from it in other desperate cases of insanity, epilepsy, or idiotism? The success of very copious bleeding in certain stubborn cases, perhaps depends in a great measure on the deliquium it produces. This has been practised on various occasions without hesitation, and yet it may be doubted whether the patient does not undergo nearly as great a risque from a suspension of life occasioned by an immoderate loss of blood, as from submersion. If any circumstances can justify the trial of such doubtful remedies, it must be the deplorable ones above mentioned, which are sometimes more formidable than death itself. It is scarce necessary to add that they ought not to be undertaken without the utmost circumspection, at least till the art of restoring animation is brought to a much higher degree of certainty.

\* Agreeable to what he affirms in his *Physic refined*, p. 281.

These circumstances clearly point out the principal indication in suspensions of life, and how necessary it is to expel foul air from the bronchial tube by a speedy supply of the most pure respirable air; and by this means to carry on an artificial respiration till the natural one can be restored:

In cases of drowning, though the admission of water into the windpipe may not be the immediate cause of death, yet may it greatly retard recovery by occupying the bronchial tubes; and by distending the lungs. Therefore before this organ is inflated, it would seem to be a great *desideratum* to be able to extract the foul air and frothy fluid by an exhausting syringè, or some proper instrument contrived for that purpose. Till this can be effected, which seems to be a work of no small difficulty, we must be content to correct or mitigate its

effects in the best manner we are able, rather certainly than relapse into the obsolete and barbarous old method of suspending the unfortunate object by the feet, and violently shaking the body with the head downwards. This practice, which used to be but too often pursued by the ignorant and vulgar, has of late years been justly exploded, as manifestly tending to extinguish the remains of life, yet strange to tell! has again been recommended by even the learned DE HAËN himself\*! It is truly mortifying that so great and eminent a Professor should, in opposition to reason, and the repeated observations of the ablest Practitioners, endeavour to revive so destructive a method, when it appears, even from his own observations, that water is not capable of being discharged from the lungs in this way. His arguments being chiefly

\* Ratio Medendi contin. — Cap. 7.

chiefly drawn from experiments on the canine species, the practice, it is sincerely hoped, should it ever be imitated, will be wholly confined to that race of animals.

The noxious air happily can be corrected now that chemistry has pointed out its counterpoison. As the concentrated acids lose their corrosive quality when neutralized with an alkali, and as the caustic alkali becomes mild by being only saturated with mephitic air, so the latter, as well as phlogiston is rendered respirable by the addition of a proper quantity of dephlogisticated air. This then seems to be the direct antidote supplied by nature for correcting the contaminated air stagnant in the bronchial cells, and also for inflating the lungs in preference to common air.



But in order to ascertain this point more fully, the following experiment was performed with the assistance of an expert, and very attentive practitioner\*.

### E X P E R I M E N T.

Having been lately engaged with the ingenious Mr. CAVALLO in procuring dephlogisticated air by decomposing nitre with a strong heat, as soon as we had obtained a considerable quantity, we secured it in clean bladders with stop cocks, for the following experiment, and for comparing its effects with atmospheric air. About this time a litter of four kittens of a month old, which were destined to be drowned, presented themselves as proper subjects for the experiment; in conducting which, each of them was successively kept under water till it became motionless and apparently dead, which  
generally

\* Mr. BIRKIT, in Great James-street.



generally happened between the space of three and five minutes. The lungs of one of them was gently inflated with a small portion of dephlogisticated air from one of the bladders. In the interim, alternate pressure was applied to the abdomen, as lately directed. The same process was tried on another with respired air blown from the human lungs. But as the tube could not be introduced into the glottis without some difficulty, and loss of time (a circumstance which perhaps too often happens in this operation) bronchotomy was performed on the third before the respired air was conveyed into the lungs. The last being only wrapt in a piece of flannel, was left entirely to nature. After waiting the event, all these animals were found irrecoverably dead, except that whose lungs had been inflated with dephlogisticated air. This animal, after the operation had been  
continued

continued a few minutes, shewed a faint tremulous motion of the under jaw, and began at length to discover other manifest signs of returning life. These increased by very slow degrees, and when it was more fully recovered, it was restored to its dam.

The inferences from hence seem obvious, but I forbear drawing any conclusions from a single experiment till opportunity shall offer of repeating it on larger animals, and with such accuracy as may exclude every suspicion of fallacy; or rather till others, who are less prepossessed in favour of dephlogisticated air, and also less reluctant to experiments of this nature, shall undertake this part of the enquiry. In the interim, I am glad to find that Mr. ACHARD has already performed a course of similar experiments on birds, and quadrupeds, the re-

sult

sult of which affords a degree of testimony which appears to be very satisfactory. In a memoir, which he presented to the Royal Academy at Berlin, he relates his having exposed chaffinches, rabbits and mice, in glass vessels, containing different kinds of noxious air which soon brought on asphyxia, or apparent death. In the space of a minute after respiration ceased, he removed them into vessels of dephlogisticated air, when they soon revived, but their recovery was rendered more speedy and certain when it was conveyed into their lungs by inflation. And what renders the experiments still more decisive, he found that common respirable air used the same way, was totally insufficient to restore the vital functions. From the result of this ingenious Academician's experiments, it would appear that dephlogisticated air greatly surpasses atmospheric

mospheric air in restoring animation when suspended by noxious air, both in birds, and quadrupeds; wherefore it seems reasonable to believe (if there was no deception in the experiments) that it may prove equally successful in re-animating the human species under similar suspensions.

2. *In preserving health and in correcting noxious vapours, or contaminated air.*

The importance of dephlogisticated air in preserving health, must be very apparent to every one who has considered its properties. Whence is it that the inhabitants of villages are so much more healthy and long-lived than those of large cities, but from the greater purity of the air which they daily breathe? But the purity of the atmosphere depends upon the proportion of dephlo-

dephlogisticated air contained in it, and which alone renders it respirable. Exclusive of this, the superior healthiness of one place over that of another similarly situated, is most commonly indeed attributed to the superior goodness of the water. But it ought to be remembered that the excellence of waters depends in a great measure on the aërial principle which they contain. Common water abounds with dephlogisticated as well as atmospheric air: if this be expelled by long boiling, the water becomes vapid and unpalatable till it has reabsorbed from the atmosphere a quantity of air equal to that which it lost by the action of the fire. On the other hand, the effects of impure air in injuring health, and in destroying life, are generally acknowledged, though too little regarded by mankind. Atmospheric air is rendered noxious in proportion as it is saturated with mephitic

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vapours,

vapours, or phlogiston, which it derives chiefly from the four following sources, namely, STAGNATION, RESPIRATION, COMBUSTION, and FERMENTATION.

1st, *Stagnation of Air.* The noxious vapours, whether of the fixed or inflammable kind, that often occur in coal mines, deep wells, and subterraneous caverns, afford many tragical instances of their destructive influence. Not long ago eight persons, in one day, fell victims to the foul air of an old drain, which had been long shut up, and was now unfortunately opened in order to its being cleansed \*. History abounds with melancholy examples of the like nature,

2d, *Re-*

\* At Narbonne, in France.—Vide Journal de Med.

T. 52, p. 149.



2d, *Respiration.* If a healthy man contaminates a complete gallon of air in a minute merely by repeatedly respiring it, we may easily explain why the air of a parlour is so considerably injured by company sitting in it, and that of a bed chamber even by a person's only sleeping in it, agreeable to the observations of Dr. PRIESTLEY and Dr. WHITE. Here too we may regret that this unhealthy tendency is not a little increased by modern refinement. The mathematical exactness with which the doors and windows of elegant houses are now contrived to shut, excludes the necessary ingress of fresh air. The diminutive size of the bed chambers is another capital error, and this is generally aggravated by the pernicious habit of sleeping with the curtains close drawn. The air thus confined becomes replete with perspirable matter exhaling from the lungs, and all the invisible

ducts of the skin, and in this contaminated state is respired for several hours. A circumstance strangely overlooked in health, and but too much neglected in sickness. In putrid and contagious fevers, it renders the room not only very offensive but highly dangerous to the patient, the practitioner, and the attendants. In close crowded rooms deprived of ventilation, when the air becomes phlogisticated to a certain degree, the candles grow uncommonly dim, and we begin to feel a disagreeable sense of oppression, languor and faintness, till fresh air is re-admitted, when these symptoms presently vanish. But should this be neglected till the air is completely contaminated, as in the dreadful scene of Calcutta, the same fatal catastrophe must naturally ensue.

3d, *Combustion*. Flame, and all burning bodies contaminate air in the same man-

ner as respiration. If a lighted taper is placed under a large glass receiver, its light gradually dwindles till at length it expires, rendering the air highly noxious. This shews the absurdity of attempting to purify pestilential air by lighting up large fires, which instead of correcting its contagious principle serve but to injure its respirable quality. Hence also appears the glaring impropriety of that profusion of superfluous fires and candles\*, which modern luxury has introduced into ball rooms, assemblies, and all places of splendid entertainment; since these, by adding to the impurity of the air, already contaminated by respiration, cannot but prove very unfriendly to health. This evidently conspires with other circumstances in rendering  
the

\* Candles composed of wax or Sperma-ceti are found to be more injurious to the air than even the commonest sort made of tallow.

the night air much less pure than that of the day. It may therefore serve to point out the pernicious tendency of that RAGE FOR LATE HOURS which so entirely possesses the polite world, and which begins to pervade even the inferior ranks of Society. The votaries of fashion in this country seem to vie with each other in converting day into night, and night into day, by reversing all the sober rules of their wiser ancestors, and in setting even nature at defiance.

A large portion of the time destined for repose is now spent in long vigils over the card table, or if it can be spared from game, it is devoted to midnight revels, or sometimes perchance to books and serious lucubrations. During this solemn period, the animal, and even vegetable tribes, yield to the powerful impulse of sleep. The latter,

latter, instead of breathing forth dephlogisticated air, now shed a baleful influence over the creation\*. While the external atmosphere is overspread with nocturnal fogs and exhalations, the hot air of the room shares the unwholesome effluvia, now superadded to the other contaminating causes. The night being thus consumed in watching, the fragrant and refreshing hours of morning intended for invigorating exercises, are spent in relaxing slumbers, and thus from day to day is the same unnatural retrograde course of life uniformly repeated. An inconsistency certainly unworthy the wisdom of the superior orders of the community, and particularly of those who preside over the common weal, and consider themselves as complete *connoisseurs* in the art of *savoir vivre*. Not only Statesmen and Senators, but Divines and Philosophers unite  
in

\* See former letter, p. 34, where it is attempted to explain the reason of this singular phenomenon.

in thus deliberately yielding up their reason and in becoming the willing slaves to this tyrannical custom. Nay even Physicians, unable to resist its all-fascinating influence, have been said to have complied with it *sometimes* (though it is to be hoped *not often*) in direct opposition to their own prescriptions! Above all it is to be lamented that so unnatural a habit is so much countenanced by the BRITISH LADIES, those ARBITERS of taste and elegance, who controul even custom, and from whose decision there is no appeal! Otherwise I would beg leave to admonish the fair delinquents, that it is not only extremely injurious to their health and vivacity, but also to their beauty and loveliness. For surely it is our duty earnestly to remind them, that whatever is subversive of the former, must ultimately prove destructive of the latter. Their still persisting in so pernicious



cious a habit, which their cooler reason cannot but condemn, it will then be considered as an impeachment of their prudence, as well as a reproach to their understanding. On the other hand, could they be prevailed on to unite in opposing it, they would take the most effectual step towards reforming the age, and establishing their own empire on the firmest basis. They might then safely rely on their natural complexion without having recourse to the wretched substitutes of art. Their native charms would render them infinitely more amiable than the whole tribe of boasted cosmetics. We should then have much less reason to regret the rapid decay of genuine beauty, and the total inefficacy of art to repair those ravages which it unavoidably undergoes in thus daily sacrificing to this goddess of folly!—But to return.—

4, *Fermentation.* The processes both of the vinous and putrefactive fermentation, being powerful instruments in extricating mephitic air and phlogiston from animal and vegetable substances, contribute largely to the contamination of atmospheric air. Hence the effluvia which proceed from fermenting liquors, from morbid humours, from putrid animal bodies, and stagnant corrupt marshes, afford numberless examples of their deleterious effects on mankind. If the health of the people ought to be an object of the first consideration in every state, and if the purity of the air be allowed to be essential thereto, is it not unaccountable that these should be less regarded in this enlightened æra than in the dark ages of ignorance! The ancients had the wisdom to place without the walls of their cities whatever might tend to injure the air, or produce putrid or contagious diseases;

diseases; yet now that philosophy has thrown new light on this subject, and the nature of the air is so much better understood, the most palpable nuisances are entirely overlooked. Is it not surprising that certain highly offensive trades, and even slaughter-houses, should be suffered, not only within the walls, but near the very center of populous cities! And is it not yet more astonishing, that the dead bodies of the inhabitants should be still permitted to be buried in church-yards, nay even in the churches themselves! A custom so highly pernicious, ought to be proscribed in every civilized nation, unless the people are determined to persist in exposing the living to certain danger, in order to render a vain honour to the ashes of the dead. The highly polluted air of large cities, in consequence of such horrid nuisances, has

Q<sub>2</sub> been

been already exquisitely described by a late eminent Poet and Physician. So very *apropos* are the following animated lines in his admired Poem on Health, that I cannot resist the pleasure of transcribing them.

“ Fly the *rank city*, shun its turbid air,  
 Breathe not the chaos of eternal smoke  
 And *volatile corruption* from the *dead*,  
 The dying, sick’ning, and the living world  
 Exhal’d to fully Heav’ns transparent dome  
 With dull mortality!—It is not air  
 That from a thousand lungs reeks back to thine,  
 Sated with *exhalations rank and fell*,  
 The spoils of dunghills, and the *putrid throav*  
 Of *Nature*, when from shape, and texture, she  
 Relapses into fighting elements:  
 It is not air,—but floats a *nauseous mass*  
 Of all *obscene, corrupt, offensive* things!”

Dr. ARMSTRONG’S Art of preserving Health.

Air once contaminated becomes totally irrecoverable by any of the remedies which have been found to correct the putridity of other bodies. In vain Dr. PRIESTLEY endeavours to purify noxious air by exposing  
 it

it to the action of the most powerful anti-septics, yet this, he afterwards found, was easily accomplished by simple agitation with water, by a sprig of mint growing in it; or, in short, by any other means of supplying it with about one fourth part of dephlogisticated air. This being discovered to be the principle by which contaminated air may be corrected, we may now comprehend the ample sources from whence nature supplies it for the purpose of purifying the atmosphere. From hence we learn how the vegetable kingdom, together with the ocean, and innumerable rivers, whose waters are agitated by the winds, do all contribute their portion of dephlogisticated air for carrying on this grand process. From hence too we may learn to avail ourselves of a remedy employed by nature, in applying it to various purposes of life, and also in supplying it occasionally by art,

even

even where nature has denied it. Being capable of forming an intimate union with phlogisticated air, it meliorates it in proportion to the quantity that is added. This points out the practicability at least of thus correcting the impure air of a close room, agreeable to what was hinted in my last. Nor would it acquire so large a quantity as might be imagined, seeing one fourth of its bulk is found to be sufficient to restore it to the ordinary standard of common atmospheric air. Moreover air, when highly contaminated, becomes the lightest and rises to the ceiling, while the dephlogisticated air, from its greater specific gravity, occupies the lower parts of the room\* where the company are assembled, provided care be taken to prevent its escape by the doors,

\* This is beautifully illustrated by the ingenious Mr. WALKER (in his Philosophical Lectures) by means of soap bubbles containing these different kinds of air.



doors, windows or chimney. For this purpose no apparatus would seem necessary, except two large earthen retorts placed in portable furnaces, or rather accommodated to proper fire places in a Pennsylvanian stove. By proper tubes with stop-cocks, the dephlogisticated air issuing from the calcined nitre, might be conveyed at pleasure, in copious streams, to all parts of the room. Being six times purer than common air, it may be presumed to prove proportionably more salutary and refreshing, and that without producing fevers, catarrhs, and rheumatisms, the common effects of the sudden admission of cold atmospheric air when all the pores are open. This might also afford a commodious method of exhibiting it to the sick, and valetudinary who wish to respire a pure atmosphere, without relinquishing the endearments of social connexions, and without  
being

being obliged to seek it solitary and unknown in a distant climate.

A laudable scheme of this nature, we are informed, has lately been attempted at Berlin by means of a new stove, invented by the ingenious Mr. ACHARD. Nor has the result disappointed his expectation: For he assures us “ that the same stove that melts  
 “ the nitre warms the apartment, and that  
 “ the dephlogistication of the air may be  
 “ thus carried to any degree that may be  
 “ judged expedient, to the great relief of in-  
 “ valids, and to the amazing advantages of  
 “ health and spirits. Hence, says he,  
 “ nervous and hypochondriacal patients  
 “ pass from a state of gloomy anxiety to  
 “ that of cheerfulness and serenity, by  
 “ only removing from the common air to  
 “ an apartment where the air has been de-  
 “ phlogisticated.” In short, it is evident  
 that this pure salubrious fluid, by proper  
 manage-

management, might be applied to the preservation of human life, not only in crowded hospitals and prisons, as mentioned in my last, but also in a variety of cases by sea as well as land, and particularly where ventilation cannot be conveniently obtained, as too often happens on board guardships and privateers, where great numbers of impressed men or unfortunate prisoners of war, are inhumanly crowded together in close places, till the air becomes highly contaminated, when the jail fever generally breaks out, and by thinning their ranks, releases the greatest part of them from their sufferings!

Dephlogisticated air appears to be no less applicable in the noted experiment of the diving-bell, or in descending into old mines, wells, vaults, and other subterraneous caverns, abounding with stagnant air, or mephitic vapours, and finally in newly-painted

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rooms,

rooms, in laboratories, smelting-houses, and certain manufactories where charcoal is burnt, and various phlogistic processes are carried on, to the no small detriment of the health and lives of the different artists.

Dephlogisticated air seems to be peculiarly adapted to the cure of diseases of the lungs, as peripneumonies, especially when the disease accompanies the measles, or confluent small-pox, also of asthmas, catarrhs, and consumptions. Because in such cases respiration is so imperfectly performed that a large portion of the phlogisticated air which ought to have been discharged by expiration, is retained in the blood, and the portion of dephlogisticated air, which ought to have been inspired from the atmosphere is, by the same cause, greatly diminished. From this retention of phlogiston the principal phenomena of these diseases seem to originate, assuming different

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ent degrees of fever according to its accumulation. This must increase in proportion as the texture of the lungs is injured by ulceration, or tubercular obstruction. Hence perhaps may be explained the nature of the hectic fever, the constant concomitant of the pulmonary consumption. From this cause probably proceed the symptoms which have hitherto been attributed to the absorption of purulent matter\* or obstruction of insensible perspiration, which seem however to be very inadequate to the effect. But whatever share the retention of phlogiston may be allowed to have in the theory of these diseases, one thing at least will be granted in practice, viz. that the air which such patients breathe ought to be rendered as pure as possible, which is the main object that is at present contended

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for.

\* This indeed has been lately controverted with great strength of reasoning in an ingenious essay on the phthisis pulmonalis, by Dr. REID.



for. Does not experience daily evince that in these cases, a free ventilation, or rather a removal from a foul phlogificated air into a much purer and serener atmosphere, produces more beneficial effects than all the powers of medicine? In vain were the most celebrated pectoral and balsamic remedies administered in the late Influenza, which continued to run its course, while the epidemic constitution prevailed. But a salutary change in the atmosphere at length ensued, which destroyed the contagious principle or checked its course, when the disease presently vanished. How far the breathing dephlogificated air, according to what was hinted in my last, might tend to correct or subdue the subtile miasmata which infest the wind-pipe, time and experience can alone discover. But should the malady revisit this kingdom after an interval of a few years (as probably  
it



it may) there certainly could be no harm or danger in making a full and candid trial of this simple element, instead of obstinately persevering in the usual routine of oily mixtures, and other unavailing modes of medication\*.

### Dephlo-

\* I am glad to find that the proposal of administering dephlogisticated air in pulmonic diseases begins to meet with the approbation of those who seem to have considered that subject with attention. Dr. REID, in particular, "thinks it is probable to prove a very valuable medicine"\*. In these cases it may be respired in a room strongly impregnated with it according to M. ACHARD's method, or by an apparatus lately described by M. CAVALLO †, or by the still simpler mode of adapting a glass syphon to the stop-cock of a bladder containing the air. In this way the remainder of the air which was left after the experiment lately mentioned, was inhaled by a hectic patient, who attributed her disease to the effects of the *Influenza*. She respired it with much satisfaction, and, as she *imagined*, with considerable advantage till it was exhausted, when she removed into the country. Indeed the quantity was far too small to determine how far it might have proved really useful, for I lay no stress on the flattering hopes which she formed on so short a trial, which did not exceed two days, and which was chiefly meant to ascertain whether this method of administering it could be easily accomplished.

\* Essay on Phthisis Pulmonalis, p. 120.

† Who also strenuously recommends it in these cases, &c.—Treatise on Air, p. 560 and seq.

Dephlogisticated air might probably be rendered very conducive to the preservation of our countrymen against the miasmata of sultry climates: particularly in those inhospitable tracts of the torrid zone, whose sickly atmosphere is fraught with contagion and death, and on whose shores it is unsafe for an European to sleep, even for the space of a single night! Humanity claims our utmost exertions to discover some more efficacious method than is yet known towards the prevention or cure of these pestilential diseases, which here continue to reign uncontrouled, and to depopulate whole provinces! Although the essence of that subtle venom which produces them, remains totally unknown, yet as it is confessedly the offspring of noxious or putrid effluvia, it might not be improper to ascertain how far this and other aërial fluids could avail.

If the contagion is received with the air, in the act of respiration, as most writers assure us, might not the breathing this pure air seem to afford the most likely means to counteract its influence? Or if it proceeds, as others imagine, from a putrid ferment in the alimentary canal, might not the liberal exhibition of fixed air (whose superior antiseptic power is well known in such cases) prove yet more successful\*?

It is now time we should consider whether some material objections may not occur to the use of dephlogisticated air. The marine scurvy, mentioned in my last, though a highly putrid disease, may perhaps be thought to afford an evident instance of this kind, because

\* Many examples of which are to be met with in the writings of Dr. PRIESTLEY, Dr. DOBSON, M. CAVALLO and others. A striking instance of its recent success after bark and elixir vitrioli had failed, was lately communicated to his Excellency Prince Gallitzin, the Russian Ambassador at the Hague.—See Lond. Med. Journal, Vol. 4, part 1st.

cause patients labouring under it, on being suddenly removed from close cabins into a purer air upon deck, have been known to express extreme uneasiness; and then presently expire. But here it may be doubted whether the fatal event was not rather owing to the sudden motion of the body, a circumstance ever to be guarded against in these cases. A more evident and weighty objection is that of certain asthmatic patients, who breathe with more ease and freedom the foggy phlogisticated atmosphere of London, after being accustomed to it, than the serene piercing air of a village. Peculiarities of this kind proceeding from long habit or peculiar idiosyncrasy may indeed furnish exceptions, but can never invalidate a general rule. Thus city valetudinarians often find themselves worse on their first removal into a champaign country, yet afterwards experience all the advantages that can  
result

result from breathing a purer air. However, as extremes are generally dangerous, it may not be adviseable, to make the transition too suddenly from a phlogisticated to a dephlogisticated medium.

The greatest obstacle to the use of dephlogisticated air, is the difficulty of obtaining it, especially in such large quantities as would be necessary for respiration, and the various purposes to which it is applicable. This, superadded to the prejudice which ever attends the introduction of a new remedy, must be acknowledged to afford no small discouragement to its use, and will, I foresee, deter the faculty from adopting it, at least till its virtues shall be more generally understood. This difficulty might be soon obviated, if chemists who are possessed of laboratories, with all the requisite utensils, would undertake to prepare it according



to the process which has been accurately described by M. CAVALLO\*. It might thus be obtained in almost any quantity, and kept in readiness; by which means its use might be rendered as familiar as that of fixed air, or any other chemical fluid, and its efficacy finally determined. He estimates the quantity capable of being contained in a very large bladder as sufficient to sustain respiration about a quarter of an hour. It may indeed be made to go farther than usual by means of lime water, or caustic volatile alkali, which tend to absorb the mephitic acid as fast as it is emitted from the lungs, but whether it can be thus rendered 30 times longer respirable, as M. FONTANA asserted, has not been yet clearly determined.

Having had no opportunity of preparing a fresh quantity of dephlogisticated air for repeating

\* Treatise on Air, p. 564.



repeating the experiments, or instituting other enquiries into its medicinal powers, which were intended; the farther prosecution of the subject must be left to those who have leisure and abilities more adequate to the task.

Where dephlogisticated air cannot be artificially prepared, yet the danger of unhealthy situations may be much diminished by improving the natural means of purifying foul air; particularly by paying greater attention to ventilation, by means of the Pennsylvanian air stoves, or by small ventilators in the upper parts of doors and windows. By cultivating in suspected rooms aquatic plants or other succulent or aromatic vegetables, that yield dephlogisticated air very copiously\*. By

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agitating

\* Such as mint, angelica, Indian-cress, &c. &c.

While writing this, I am favoured with the following observation by a very ingenious Practitioner at Boerhamwood,

agitating fair water, and exposing it to the air; also lime water to absorb mephitic vapours; and lastly by frequent admission of the sun-beams, by whose emanations plants and water yield forth their dephlogisticated air

wood \*, whom I have the pleasure to find concurs with me in earnestly wishing to counteract the destructive effects of contaminated air, especially in populous cities.

“ Among the plants, says he, which I should prefer for this purpose (and which will thrive in almost any soil or situation) are the large annual *sunflower* †, the *angelica*, and the *common gourd*. The first is eligible on account of its excessive perspiration, being in 24 hours 19 times greater than that of a man. The *angelica*, is a hardy perennial plant and well adapted by reason of its luxuriant growth, easy propagation, and strong aromatic odour. The *gourd* is also of quick growth, and perspires abundantly, and may be farther useful in cover-walls, pales, &c. But besides the perspiration of plants, they have yet another valuable property, which is that of greedily imbibing foul phlogisticated air, which they appear to receive by a series of vessels different from those through which they expire their salubrious effluvia.”

\* Mr. S. Saunders, late of Barnet.

† Flowers, even of the most fragrant kind, have indeed been accused by Dr. INGENHOUSZ of injuring the air, but I am glad to find that they have been since acquitted of this charge by the result of later experiments; so that the sunflower here recommended by my learned correspondent, may still prove an important acquisition in the above intention.

air more plenteously. In the dark they emit noxious air, as has been already noticed, nor can any degree of heat without light, force them to part with dephlogisticated air, or contribute to purify air that is contaminated. Light then seems to be more conducive towards diffusing this vivifying principle through the atmosphere than heat.

Who has not experienced the exhilarating effects of bright sunshine compared with the langour and oppression occasioned by an equal degree of warmth in a hot-house, or during the sultry darkness of a thunder-storm? The intimate connexion that subsists between dephlogisticated air and the rays of light, shews that the latter is not less essential to animal than vegetable life, and may also afford a new explanation why the presence of the sun gladdens all nature, and why a general gloom and melancholy overspreads the creation when he withdraws

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his enlivening rays, or undergoes an eclipse. And finally, why physicians err who indiscriminately deprive their patients of the cheerful beams of day, since by shutting out light (unless where it is too powerful for the organs of vision) they not only injure the air, but also add to the horror of a sick room.

Thus it appears that the air which we breathe, is liable to be influenced by a variety of causes \*. That many of those are more within human power, even  
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\* Among these, planetary influence ought perhaps to have been enumerated, since to this cause, epidemic and contagious diseases have frequently been attributed. Its sphere of action however being so remote, and so infinitely beyond our reach, it was purposely omitted. That the superior planets under certain aspects, when their united rays fall fully on the earth, may tend to phlogisticate its atmosphere, and affect the weather is by no means improbable. Whether the late remarkable conjunction of Jupiter and Saturn, might not thus contribute to this distemperature of the air, which produced the Influenza, I leave others to determine.

in the worst situations, than has been commonly imagined. That finally, its noxious qualities might be often prevented, or at least greatly diminished by the attentive interposition of a well regulated police, or more properly by a BOARD OF HEALTH appointed for that purpose.

### 3. ITS IMPORTANCE IN CHEMICAL INQUIRIES.

Dephlogisticated air may also be rendered farther subservient to the views of the accomplished philosopher in analyzing and calcining bodies, and in expediting various other chemical processes. It is evidently a principal agent in the detonation of nitre, the explosion of gunpowder, and aurum fulminans. The intense heat which it gives to ignited charcoal dissolves a considerable rod of iron in a few seconds, and reduces speedily into a fluid form some of the  
 most



most refractory substances, not even excepting the Platina. Being the only supporter of heat, and of flame, it evidently nourishes volcanos and other subterraneous fires, and may perhaps afford a new and satisfactory solution of the long controverted question concerning the warmth of certain mineral springs, such as Bath, Buxton, Aix-la-Chapelle, &c. Whether this subtle fluid is not in reality the elementary basis of atmospheric, and other aërial substances, and whether it may not be considered as contributing to the principle of light, of colour, and of acidity, may be worthy the researches of experimental Philosophers. In the interim, the splendor which it imparts to burning bodies, the florid colour it gives to blood, and to the calces of metals, and the acid taste to aquafortis, at least serve to countenance this opinion.

If



If dephlogisticated air is so essentially necessary to animal life, and so very important to mankind, in various other respects, it may be asked why nature did not supply us with it in its genuine state, without that alloy of phlogiston with which atmospheric air is constantly debased? To which it may be answered, that it would have been incompatible with the peculiar structure of vegetables, which require a daily supply of phlogiston as absolutely necessary to their growth and nutrition. For plants are discovered to dwindle and grow sickly in dephlogisticated air, and to revive and flourish when removed into impure air. Therefore the air which they receive in a phlogisticated state, after it has answered this end, is restored to men in a more pure and respirable form. Hence the more air is imbibed by vegetables the more pure it becomes for animals, and the more frequently

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it is respired by animals the more nourishment it yields to vegetables. Hence too the common atmosphere, in its present constitution, proves congenial to the vital principle of both. And it is no less observable that the same air which preserves them during life, destroys them after death, by exciting putrefaction and resolving them into their first principles. In the living state, the vital power resists this action of the air, but when life is extinct both animals and vegetables yield to the general law which hastens their decay, because dead substances would only encumber the creation, whereas by speedy dissolution their particles of matter again become fit to assume new forms and undergo new combinations.

With what admirable œconomy has the Divine Architect established this reciprocal intercourse between the animal and vegetable kingdom! By what elegant

simplicity of design are the different parts of nature thus rendered at once subservient to the mutual benefit of each other, and to the general well-being and harmony of the whole !

2d, ELECTRICITY—*Its extensive influence—its application to medicine—particularly in RESTORING ANIMATION.*

Electricity claims the attention of the Physician, as well as the Philosopher, in proportion as it may affect the health and well-being of mankind, by its extensive influence through the various parts of nature. In the atmosphere its effects are awfully sublime and magnificent in the phenomena of thunder, lightning, and the aurora borealis. It moreover seems to influence materially the state of the weather in the formation of hail, rain, snow and me-

teors. Atmospherical electricity therefore ought probably to be considered as the basis of meteorological science. Though hitherto it has been little noticed, except in thunder storms, yet mankind are perhaps not less interested in its more silent variations than in those of the magnetic needle, or the vicissitudes of the winds, or temperature, all which have been diligently observed, and minutely recorded.

In the bowels of the earth the electric principle seems to be no less active in the production of earthquakes and volcano's than in the mineralization of ores, and fossils, while on its surface it is acknowledged to promote the vegetation of plants, and the incubation\* and growth of animals.

In

\* By the application of electricity, in a certain determinate degree, to impregnated eggs, we are informed that incubation was so remarkably accelerated, that the chickens were hatched in about 38 hours. — Mem. de l'Acad. des Scien. de Berlin, 1778.

In medicine, it presents us with a more speedy and powerful stimulant, and at the same time more manageable than any hitherto discovered. With respect to the present subject, whoever considers its effects in increasing the action of the heart and arteries, in accelerating the circulation of the blood, and consequently in promoting the progressive motion of all the animal fluids, will scarcely hesitate to acknowledge it as a suitable agent for restoring suspended animation. Among the chief stimulants recommended for exciting the vital organs are neutral and volatile salts, together with friction, emetics, and fermentatives. These have, it is true, been employed with considerable advantage, but their power, it must be acknowledged, is of a limited nature, and is also weak and superficial when compared with that of electricity.

It is to be regretted indeed that the comparative merit of electricity in these cases, has not been oftener put to the trial. There are not wanting however some instances of its effects, which are sufficient to claim our attention.

“ The electrical shock was tried upon the  
 “ body of J. Lawson, *four hours* after he was  
 “ taken out of the water, every other me-  
 “ thod having been tried in vain. The effects  
 “ it produced were of such a nature as to  
 “ evince how beneficial it may prove in  
 “ more favourable circumstances. The  
 “ first shock excited a pulsation in the tem-  
 “ poral artery ; the next diffused a florid  
 “ colour over the face, and occasioned the  
 “ blood to flow in a copious stream and to  
 “ a considerable quantity from an orifice,  
 “ which had been opened in the jugular  
 “ vein at the beginning of the process,  
 “ without



“ without a drop having issued from it \*.”

Four hours being elapsed before electricity was tried, it will not appear wonderful that no farther progress could be made towards restoration. In cases of drowning, indeed, the recovery seems to be more difficult than in other accidents. This difficulty is yet more observable in the canine than in the human species. DE HAEN, in his numerous experiments on these animals, was scarcely able to recover above one in eighteen. All the approved modes of treatment (we are told) proved extremely unsuccessful, and among the rest, electricity. Are we to conclude from thence that all human efforts to restore drowned persons are fruitless, and that electricity is equally ineffectual? By no means; the former conclusion is contrary to experience, and also flatly contradicted by the authentic Reports  
of

\* Reports of the Humane Society, 1775, page 77.

of the Humane Society, and other similar institutions in various parts of Europe. The latter seems to be no better founded, since it appears, even from the Professor's own account, that the electrization in general was but very imperfectly performed; the fluid, through inattention to conducting bodies, being inadvertently dissipated. His want of success therefore, ought by no means, to discourage other expert electricians from attempting to ascertain its efficacy by a more accurate, and satisfactory course of experiments. Till this is accomplished, the Medical Assistants may be deterred from availing themselves of this remedy in those unfortunate accidents wherein it is particularly indicated.

“ Catharine Sophia Greenhill, on fall-  
 “ ing from a one pair of stairs window up-  
 “ on the paved stones, was taken up to all  
 “ appearance

“ appearance dead. An apothecary being  
 “ sent for, he declared nothing could be  
 “ done for the child. Mr. Squires, who  
 “ lives opposite to where the accident hap-  
 “ pened, finding the case hopeless, with  
 “ the consent of the parents very humanely  
 “ tried the effects of electricity. At least  
 “ *twenty minutes* had elapsed before he  
 “ could apply the shock, which he gave  
 “ to various parts of the body without any  
 “ apparent success; but at length, upon  
 “ transmitting a few shocks through the  
 “ *thorax*, he perceived a small pulsation:  
 “ Soon after the child began to sigh and to  
 “ breathe, though with great difficulty,  
 “ and at length was restored to perfect  
 “ health and spirits\*.”

Thus was the child happily recalled from premature death, who must infallibly have

U perished,

\* Reports of the Humane Society, 1774, p. 32.

perished, had it not been for the timely and prudent use of electricity. Had Mr. Squire even neglected transmitting the electrical fluid through the thorax, after it had failed in other directions, the event would still probably have proved fatal,

Here it may be proper to remark, that the success of electricity depends greatly on the mode of conducting the operation. According to the strength and direction of the electrical current, it may be made to produce different, or even opposite effects. Thus Dr. ABILGARD, in his celebrated experiment on fowls, was enabled alternately to suspend or restore animation\*. However surprising, or even incredible, the result of this experiment may appear to some persons, yet a very ingenious ELECTRICIAN †, assures me, that some time ago

\* Mentioned in the former Letter, p. 22.

† Mr. Partington, in Cavendish-square,

ago he repeated it with similar success, particularly on a large turkey. Very lately he has afforded me ocular demonstration of this singular fact in a young quadruped of the canine species; a smart shock or two being made to pass through its head; it immediately became motionless, and to all appearance dead. In this state, electricity was used in different degrees, and conveyed in different directions. When it was gently transmitted through the region of the heart and lungs, oscillations of the muscles immediately ensued. What seemed very worthy of attention, the vital organs were thus more certainly excited, and more vivid motions produced by slight than by rougher shocks; the latter appearing rather to retard than to promote recovery. When the operation was suspended for a few minutes, or its direction altered to remote parts, the animal always relapsed into its quiescent state, and

as constantly revived, on its being repeated in the situation above mentioned. By repeating at intervals, sparks or very minute shocks, it was at length completely revived. Thus the vital organs are, under certain circumstances, more powerfully agitated by very slight than by very strong *stimuli*. Hence tickling the soles of the feet produces convulsive laughter, while rubbing them strongly, occasions no sensible effect. Thus the heart palpitates on sight of a spider, which remains tranquil in the midst of a bloody engagement. And thus the lungs are thrown into vehement agitation by a drop of water, or a portion of insipid phlegm, which bear the loudest exertions of the voice with impunity.

In order then to give electricity its utmost power in restoring animation, it would seem necessary that it should not  
only



only be applied to the thoracic viscera, but that the utmost care should be taken to adjust its tone, or (if I may be allowed the expression) to bring it into perfect unison with the vital organs. The due medium for this purpose may be difficult to determine *a priori*, though it may be ascertained by dint of repeated trials. Accordingly the experiment failed in two instances of drowned animals, nor is this to be wondered at, when we consider the feeble state of the vital principle of life in these very young creatures. However, if but one case in ten of apparent death, among the human species that resists the ordinary means, could be restored by electricity, it would still certainly merit our attention.

The experienced Practitioner above mentioned farther informs me, that he has  
found

found electricity to be one of the most speedy and certain methods of removing the syncope, and fainting occasioned by sudden emotions of mind; also of the unfortunate accidents of persons struck by lightning. Thus may electricity prove a most useful *remedy* even of its *own excesses*. Nor is there any real inconsistency in this, seeing its effects may be so greatly diversified, according to the mode of applying it. Thus it may be caused to pass silently along an iron wire, to visibly shorten or elongate the same, or finally to dissolve it, according to circumstances. The same apparent difficulty occurs in various other instances. Thus a strong current of air extinguishes the burning taper, while a gentler breeze rekindles it. Excessive cold benumbs the limbs, and yet the application of snow restores them to sense and feeling. But it is

needless to have recourse to analogical reasoning, when facts can be produced.

The following account communicated by a friend relates to a case of public notoriety.

“ On Thursday the 18th of June, 1782,  
 “ in the severe thunder-storm, a house in  
 “ Gravel-lane, Southwark, was struck  
 “ with lightning, and an elderly man was  
 “ thrown with violence from his chair,  
 “ and taken up for dead. In this hopeless  
 “ state electrization was performed by a  
 “ skilful Practitioner of Guy’s Hospital,  
 “ by which remedy the man was at length  
 “ entirely restored.”

In cases of apparent death from lightning, the unfortunate objects are too often deserted, when they might probably be recovered by inflating the lungs, or pursuing  
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ing the general plan proposed in suspensions of life from other causes\*.

The Humane Society have recorded a very remarkable instance of this, in the case

\* Forty years have now almost elapsed since the probability of restoring persons apparently dead from *this* and *other* causes, was suggested by my late truly VALUABLE FRIEND, Dr. JOHN FOTHERGILL! Prompted by the noblest of all motives, an ardent zeal of preserving his fellow-creatures from premature death, he discovered uncommon solicitude to animate others to the same laudable pursuit. The observations which he communicated to the Royal Society\*, at a time when the subject was so little understood, do honour to his humane feelings, and likewise exhibit an early specimen of that *medical acumen*, by which he was afterwards so eminently distinguished. His idea of the "possibility of saving a great many lives without risking any thing" has since been very amply confirmed by experience; and if his hint for instituting experiments on condemned malefactors, had been properly attended to, the art of restoring animation would probably have made a much greater progress, and it can hardly be doubted that acts of atrocious villainy would have been more effectually repressed.

\* Now inserted in the first volume of his works, with suitable notes, by the learned Editor, Dr. LETTSON.

case of Peter Lucas, a youth of eighteen, who was brought home seemingly dead in consequence of a stroke of lightning. By the use of blisters, volatiles, and strong friction assiduously pursued, under the direction of Mr. Milward, the young man was at length happily restored \*. Whether electricity be not applicable to almost every case of suspended animation; and whether there be any instance that excludes it, except that which proceeds from profuse hemorrhage, must be left to future observation to determine. Likewise whether the effects of positive electricity be essentially different from those of the negative; as the former, *ceteris paribus*, appears to be weaker than the latter. This apparent difference however probably depends on the following circumstance. In positive elec-

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tricity,

\* See Reports of the Humane Society for 1773.

tricity, the fire is presented to the patient, in a pencil of diverging rays, and is diffused over a considerable surface, by which its action is rendered milder. In the negative, it is made to issue from his body, in converging rays, as from a point, by which it is of course felt with more poignancy\*.

3d, H E A T—*Its efficacy in restoring animation—particularly illustrated in torpid animals.*

Heat is so essential to animal life, that without it, the embryo in the fecundated egg, would for ever remain in an inanimate state. By a certain degree of heat it is called forth into being, whether this is communicated

\* The most commodious apparatus I have yet seen, for exhibiting medical electricity, in every possible direction, and even without an assistant, is that lately contrived by Mr. NAIRNE, mathematical-instrument maker.



nicated by the hen during incubation, or by an oven heated to the same standard, namely, about 106 of Fahrenheit's thermometer. Hence the myriads of animated beings, which, from imperceptible ova, are ushered into existence by the summer's sun.

Heat is no less necessary to viviparous than to oviparous animals. The human heat amounts to  $98^{\circ}$  of Fahrenheit's thermometer; this being congenial to the healthy state of the body, points out the degree which seems best adapted for restoring animation. Accordingly the efficacy of the warm Bath has been experienced in various cases of apparent death, especially from drowning. Its success probably results from stimulating the cutaneous nerves, and preventing the coagulation of the blood, which is so soon apt to commence on its total stagnation.

When the warm Bath cannot be speedily procured, a partial application of heat may prove very beneficial. Hence a warm sunshine has more than once, afforded an useful auxiliary on those occasions. This circumstance might be improved when the weather is favourable, by collecting the solar rays in the focus of a lens or speculum, and directing them with more or less intensity, upon different parts of the body. This method of applying heat (so far as I know) has never yet been suggested with this view, though it may evidently supply a stimulus of the most powerful kind. By thus directing the concentrated rays, with due caution, on the eye, the pupil would not fail to contract, if the muscular fibres of the iris retained even the smallest degree of irritability. Might not this afford a method of discovering whether any remnant of life yet remained in the other parts of the body, and

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consequently lead us to a new criterion between real and apparent death?

The wonderful influence of heat in rousing the dormant powers, and in renewing the circulation of the stagnant blood is finely illustrated by its effects on torpid animals, which sleep during the cold and rigorous season of winter, and regularly awake on the approach of the genial warmth of spring. M. BUFFON, in his natural history, relates many curious particulars concerning this class of animals. He observes that the German Marmot, a rat of this kind, almost as big as a rabbit, is known to shut itself up under ground on the approach of the cold season, where it falls asleep, becomes stiff, and feels as cold as ice. When opened, the intestines shew no signs of irritability, even on the appli-  
cation

eation of spirit of wine, or oil of vitriol.  
 “ It is curious, says the Historian, to ob-  
 “ serve him passing from the torpid to an  
 “ active state. He first loses the rigidity of  
 “ his limbs, stretches out his legs, fetches  
 “ a deep sigh, yawns and opens his mouth,  
 “ and utters rattling sounds like a man in-  
 “ toxicated. Such are the inconveniences  
 “ he undergoes from a sudden and forced  
 “ reviviscence, which is probably per-  
 “ formed in a slow and imperceptible man-  
 “ ner, when left in his hole. Warmth  
 “ accelerates, and cold retards his restora-  
 “ tion, and the change is observed to keep  
 “ pace with the degree of temperature.  
 “ But what is very singular, he does not  
 “ become stiff and torpid when exposed to  
 “ a degree of cold equal to freezing, pro-  
 “ vided he is kept in the open air instead  
 “ of a close place.”

In high northern latitudes, it is asserted by travellers, that eels, during the cold season, are sent to distant places in a frozen state, and are afterwards by immersion in cold water, gradually restored to life\*. These instances afford striking examples of what I lately hinted concerning the remarkable attachment of the vital principle to muscular fibres even long after motion and sensation have ceased; and at the same time strongly evince the powerful influence of heat in rousing it into action. The use however of heat in the recovery of persons apparently dead, requires much prudence and circumspection in its application. If applied too hastily, or in too great degree to persons

\* The term *cold water*, probably implies the temperature to be but a few degrees above the freezing point. Otherwise the transition from congelation would appear too great, since water heated only to the temperature of human blood, scalds fishes to death.—See Martin's *Ess. Med. and Phil.* p. 243.

fons frozen, instead of re-animating the latent principle of life, it presently extinguishes it, by producing gangrene and sphacelus. In suspensions occasioned by the fumes of burning charcoal, or mephitic air, the application of cold is found to be salutary, while heat proves injurious, and even brings on a relapse after a considerable progress has been made towards restoration \*. Whether other exceptions may not occur to the use of heat in restoring animation, must be decided by future observation. In the mean while, the judicious Practitioner will make the proper distinction between the effects of heat applied medically and those of hot phlogisticated air occasioned by the accidental closeness of the room, or superfluous number of useless spectators. Because the latter circumstance must

ever

\* See Reports of the Humane Society for 1776.



ever retard the desired recovery from whatever cause life is suspended.

The theory of animation is a wide field abounding with new objects, which engage our attention at almost every step, but the present excursion will only permit us to take a short and transient glimpse of those that appear to be most interesting. To other observers who may be inclined to take a larger range; and to contemplate them at leisure, these cursory hints are cheerfully offered, hoping they may tend, in some measure, to facilitate their researches. Before we can expect to complete our views on this subject, many difficulties still remain to be explained; concerning which we can now only offer probable conjectures. Such however may not be without their use, if they lead to farther investigation. Therefore the following queries relating to some

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of

of the principal *desiderata*, are humbly submitted to the candid reader, either to be adopted or rejected, according to their verisimilitude.

## Q U E R I E S.

1. If plants cannot thrive without phlogiston, nor animals subsist without dephlogisticated air, is it not evident that the former may be considered as essential to the principle of vegetation, and the latter to that of animation ?

2. As dephlogisticated air is inhaled with atmospheric air into the lungs, and finds an easy passage from thence into the blood vessels (as appears from the more florid hue which the blood acquires in its course through that organ) may not these two opposite principles, viz.  
 phlogiston

phlogiston and dephlogisticated air, be intended to counteract and balance each others effects in the system?

3. So strong is their chemical affinity that they quit all other substances to unite with each other. May not the collision resulting from their mutual union; in the body, be the cause of animal heat, as it is acknowledged to produce flame and combustion out of the body?

4. Though irritability is said to be a property inherent in living solids, yet it requires to be continually supported by dephlogisticated air received into the lungs, since it soon forsakes the muscles when respiration is suppressed. Does not this discover the source from whence the principle of irritability derives its energy?

5. Does not this moreover seem to shew, that the nervous influence, which is considered as the proper medium of motion, and sensation, depends essentially on dephlogisticated air for its support and activity?

6. As the blood is generally allowed to be the fountain of life, and as dephlogisticated air is continually passing into the blood vessels, does not the latter seem better calculated to actuate the vital organs than the electrical principle, which is so liable to be dissipated every moment, by the general conducting power of all the animal fluids?

7. Dephlogisticated air being rendered effete by its union with the phlogiston of the blood, requires to be constantly evacuated, and renewed from without. Does not this shew the great importance of the lungs,  
and

and why the blood requires to be incessantly fanned by this pneumatic engine, and why if this operation is suppressed, its animating principle, like expiring embers, fades, languishes, and becomes extinct?

8. Does not this also explain, why the new-born infant, having once respired air, is ever after under a necessity of continuing that process to the last moments of life?

9. Does not the phlogistication of a portion of air by passing the electric spark through it, point out the cause why a strong flash of lightning, by suddenly contaminating the vital *aura*, deprives the muscles of irritability, and consequently destroys at once, all sense and motion?

10. May not the torpid state which the marmot, and other dormant animals undergo  
in

in their cells, and not in the open air, be owing, in a great measure, to the sedative effects of the stagnant atmosphere which surrounds them, when shut up, and which becomes highly phlogisticated by their respiration?

11. Should this supposition be confirmed by future observation, will it not suggest an additional argument for the use of dephlogisticated air, and free ventilation, in the recovery of persons apparently dead?

12. If animal life subsists till the natural heat is extinguished, might it not be of consequence, to ascertain with precision, the degree of temperature of animals in the torpid state, and also in the suspension of life from drowning and other causes?

13. Might not the difference of temperature that obtains between this, and the entirely



entirely inanimate state, though too minute to be distinguished by our sense of feeling, become sufficiently evident by the thermometer, so as to afford a more certain test of the presence or absence of life?

Farther objects of enquiry might be here suggested, but I have already trespassed too long on your patience, and perhaps indulged speculation beyond what may be thought consistent with the prudential maxims of sound policy. Formerly indeed whoever presumed to think for himself, or to step out of the common road of practice, with a view towards the advancement of the healing art, exposed himself to the keenest shafts of criticism. Though it is to be hoped the present age is too enlightened, to discourage liberal enquiry, yet still there are not wanting certain brethren, who

3. have

have ever been accustomed to pace it along the beaten track, in all the trammels and accoutrements of system; and to spurn at others as innovators, if they but attempt to throw off the shackles, or to introduce any useful improvements. From such men, I expect no quarter; because their unfortunate bias disposes them to be captious, and like the jaundiced-eye, obliges them to view objects through a false medium. Should they indiscriminately condemn the present Hints, I shall by no means dispute the justice of their sentence, because no one perhaps can be more truly sensible of their imperfections, or at the same time more ready to acknowledge them, than the Writer. If those however, who undertake to criticize, would but deign candidly to point out the exceptionable passages (which may possibly be more numerous

ious even than he imagines) he will be extremely willing to profit by any remarks they may contribute to the improvement of his plan. He will even listen to such strictures as may ~~be~~ tend to sap its foundation, provided it can be proved to be groundless, and that a better may be established in its room. For weak and unteachable is the citadel whose walls are unable to sustain a hostile assault without being dismantled. In short, if what he has offered in favour of dephlogisticated air, electricity and heat, as deduced from their known properties, and the experiments of the most eminent Philosophers, be not well founded, the ground-work, as well as the superstructure, will be in danger of being demolished. Even then, he will have still one consolation at least, viz. that of falling with such very respectable company. Happily, in the interim, the parties concerned can suf-

fer no injustice by submitting the decision to the candour and indulgence of an IMPARTIAL PUBLIC;

To WHOM I am, with the utmost respect,

Dear Sir,

Your's very sincerely,

A. F.

London,  
May, 27, 1783.

T H E E N D .

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E R R A T A .

- P. 56, l. 23, for *juify*, read *justify*.  
---, 24, for *it*, read *they*.  
73, 2, dele *it*.  
76, 23, after *vain*, add *did*, and dele *s* in *endeavours*.  
78, 8, for *acquire*, read *require*.  
81, 4, for *cases*, read *situations*.  
83, Note, after *this*, add *generally received opinion*.  
91, l. 9, read *situations*.  
92, 7, read *earnestly*.  
94, 22, Note, for *this*, read *that*, and omit *thus*.  
95, 8, ~~three~~ Italics instead of Small Capitals.  
99, 12, omit *and well being*.  
103, 20, after *and*, add *is*.  
109, 12, omit *of life*.  
112, 9, for *zeal of*, read *zeal for*.  
119, 16, read *great a degree*.